

We claim:

1. A closure for a container comprising:
 - (a) an inner cylindrical wall having first and second ends and
5 defining a space;
 - (b) an outer cylindrical wall opposite the inner cylindrical wall and
having said first and second ends to form an outer surface of the closure;
 - (c) a first end wall extending across said first end, wherein said first
end wall comprises a recess extending at least partially into said space, and a
10 first set of threads disposed on said recess.
2. A closure for a container as claimed in claim 1, further
comprising:
a second set of threads disposed on said inner or outer cylindrical wall
15 having a direction which is opposite that of the first set of threads.
3. A closure as claimed in claim 2, wherein said first set of threads
have a left hand direction, and said second set of threads have a right hand
direction.
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4. A closure as claimed in claim 3, wherein the closure comprises
a plurality of ramp-shaped protrusions which extend in a direction away from
the closure.
- 25 5. A closure as claimed in claim 3, wherein a portion of the end
wall surrounds the depression and comprises a plurality of ramp-shaped
protrusions arranged along the radial perimeter of the end wall and extend in
a direction away from the second end.

6. A closure as claimed in claim 3a, wherein the ramp-shaped protrusions are adapted to engage corresponding elements on a removal device.

5 7. A closure as claimed in claim 2, wherein said second set of threads is disposed on said inner cylindrical wall and said outer cylindrical wall comprises a plurality of vertically extending ridges.

8. A closure as claimed in claim 2, wherein the recess comprises
10 an second end wall disposed opposite the first end wall.

9. A closure as claimed in claim 8, wherein the recess is adapted to receive a threaded spindle and the second wall arrests the downward movement of the threaded spindle.

15 10. A closure as claimed in claim 1, further comprising a plug seal located between said depression and outer cylindrical wall adapted to frictionally engage the a container being sealed.

20 11. A closure as claimed in claim 1, further comprising a crush rib located at the first end wall and adapted to be biased against a container when the closure is on the container to provide a sealing effect.

12. A closure as claimed in claim 1, further comprising a separate
25 resilient seal to engage the container.

13. A closure as claimed in claim 1, wherein the seal comprises a gasket seal.

30 14. A closure for a container comprising:

(a) an inner cylindrical wall having first and second ends and defining a space;

(b) an outer cylindrical wall opposite the inner cylindrical wall and having said first and second ends to form an outer surface of the closure;

5 (c) a first end wall extending across said first end, wherein said first end wall comprises a recess extending at least partially into said space, and a first set of threads disposed on said recess; and

(d) a second set of threads formed disposed on said inner cylindrical wall having a direction which is opposite that of the first threads.

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15 15. A combination container and a closure comprising the closure as claimed in claim 1 and a container having an opening at one end adapted to receive the closure.

15 16. A combination container and a closure comprising the closure as claimed in claim 2 and a container having an opening at one end adapted to receive the closure, wherein at least the opening of the container is cylindrical and has threads disposed in the vicinity of the opening adapted to receive the second set of threads.

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17. A combination container and closure as claimed in claim 16, wherein the threads are disposed on the outer surface of the container and the second set of threads are disposed on the inner cylindrical wall.

25 18. A combination container and closure as claimed in claim 16, wherein the container comprises two cylindrical containers connected by a rib to prevent rotation of the containers when the closures are being removed.

30 19. A combination container and closure as claimed in claim 18, wherein one of the two containers is tapered at the bottom.

20. An apparatus for removing and installing a closure on a container comprising:

a threaded rotatable spindle adapted for threading into a closure having a threaded depression and for applying a rotational force to remove
5 the closure; and

a clutch having an element adapted to engage the closure and apply a rotational to the closure.

21. An apparatus for removing and installing a closure on a
10 container as claimed in claim 20, wherein the threads on the spindle are coarse.

22. An apparatus for removing and installing a closure on a container as claimed in claim 20, wherein the spindle further comprises a
15 shaft portion and the clutch further comprises a sleeve surrounding the at least a portion of the shaft portion, whereby the clutch is translatable in a direction along the axis of the spindle, but is stationary relative to the spindle in the direction of rotation.

20 23. An apparatus for removing and installing a closure on a container as claimed in claim 22, wherein the shaft is square or has splines.

24. An apparatus for removing and installing a closure as claimed in claim 22, further comprising a spring for biasing the clutch in a direction of the
25 threaded spindle to engage the closure and for apply an axial force to the closure.

25. An apparatus for removing and installing a closure as claimed in claim 22, wherein the element adapted to engage the closure and apply a
30 rotational force to the closure is located on the end of the sleeve substantially perpendicular to the spindle.

26. An apparatus for removing and installing a closure as claimed in claim 25, wherein the element comprises a plurality of protrusions arranged along the radial perimeter of the end of the sleeve extending in a direction
5 toward the spindle and adapted to engage corresponding ramp-shaped protrusions on the closure.

27. An apparatus for removing and installing a closure as claimed in claim 26, wherein a cross-section of the protrusions is in the shape of a ramp-
10 shaped triangle having a flat top surface.

28. An apparatus for removing and installing a closure as claimed in claim 26, further comprising a carriage for holding and transporting the spindle and clutch and a motor for rotating the spindle and clutch.

29. An apparatus for removing and installing a closure as claimed in claim 28, wherein the motor is mounted in the carriage and further comprising a drive pulley on the spindle and a belt to connect the drive pulley with the
15 motor.

30. An apparatus for removing and installing a closure as claimed in claim 28, further comprising a radial drive motor for moving the carriage in a horizontal position from a position over the closure to a position away from the
20 closure.

31. An apparatus for removing and installing a closure as claimed in claim 26, further comprising a vertical drive motor for moving the carriage in a vertical direction.
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32. An apparatus for removing and installing a closure as claimed in claim 26, further comprising sensors for detecting a vertical and radial position of the spindle.

5 33. An apparatus for removing and installing a closure as claimed in claim 20, further comprising the closure, wherein the threads on spindle and threaded depression are coarse.

34. An apparatus for removing and installing a closure as claimed in
10 claim 33, wherein the weight of the closure causes the spindle and closure to become unscrewed without the element on the clutch engaging the closure to prevent rotation of the closure relative to the spindle.

35. A method for removing a closure on a container comprising:
15 providing a closure according to claim 1 arranged on a container;
providing a rotatable threaded spindle
bringing the rotatable threaded spindle into proximity with the recess on the first end wall;
screwing the threaded spindle into the first set of threads on the
20 recess; and
moving the threaded spindle having the closure threaded thereon away from the container, thereby removing the closure from the container.

36. A method according to claim 35, wherein the recess comprises
25 a second end wall disposed opposite the first end wall and the threaded spindle is screwed into the depression until it reaches the second end wall.

37. A method according to claim 35, wherein the weight of the closure and the engagement of the threaded spindle with the threaded recess
30 is sufficient to unscrew the closure from the threaded spindle when the closure is not supported on the container, and the method further comprises

providing a clutch having an element adapted to engage the closure and apply a rotational force to the closure, engaging the element with the closure to prevent the spindle from being unscrewed from the closure.

5 38. A method according to claim 37, wherein a portion of the first end wall that surrounds the recess comprises a plurality of ramp-shaped protrusions arranged along the radial perimeter of the first end wall and extend in a direction away from the second end, and wherein the elements of the clutch and the ramp shaped protrusions abut each other during the
10 engagement of the element with the closure to prevent rotation of the closure relative to the clutch.

 39. A method for installing a closure on a container comprising:
 providing a closure according to claim 1;
15 providing a rotatable threaded spindle having the closure screwed thereon, wherein the weight of the closure and the engagement of the threaded spindle with the threaded recess is sufficient to unscrew the closure from the threaded spindle when the closure is not supported on the container;
 providing a clutch having an element adapted to engage the closure
20 and apply a rotational force to the closure;
 engaging the element with the closure to prevent the spindle from being unscrewed from the closure;
 moving the threaded spindle having the closure screwed thereon into proximity with an opening on the container; and
25 rotating the spindle and clutch in a direction to unthread the spindle from the closure.

 40. A method according to claim 39, wherein the closure has a second set of threads disposed on the inner or outer cylindrical wall having a
30 direction which is opposite that of the first set of threads, and at least the opening of the container is cylindrical and has threads disposed in the vicinity

of the opening to receive the second set of threads to form a sealing closure,
and

wherein the rotation of the spindle and clutch and the engagement of
the clutch element with the closure provides sufficient rotational force to
5 thread the closure onto the container.

41. A method according to claim 40, wherein a portion of the first
end wall that surrounds the recess comprises a plurality of ramp-shaped
protrusions arranged along the radial perimeter of the first end wall and
10 extend in a direction away from the second end, and wherein the elements of
the clutch and the ramp shaped protrusions abut each other during the
engagement of the element with the closure to prevent rotation of the closure
relative to the clutch until a predetermined torque is reached, and wherein
when the predetermined torque is reached, the clutch and spindle rotate
15 relative to the closure and the spindle become unthreaded from the closure,
thereby releasing the closure.

42. A method according to claim 41, further comprising moving the
spindle and the clutch away from the closure when the closure is released
20 from the spindle.

43. An analyzer comprising:
a metering probe capable of dispensing or aspirating a liquid;
an incubator;
25 a measurement system for measuring a parameter of a sample;
a combination container for containing a reagent and a closure
comprising the closure as claimed in claim 1 and a container having an
opening at one end and adapted to receive the closure; and
an apparatus for removing and installing the closure on the reagent
30 container comprising:

a threaded rotatable spindle adapted for threading into a closure having a threaded recess and for applying a rotational force to remove the closure; and

5 a clutch having an element adapted to engage the closure and apply a rotational force to the closure.

44. An article of manufacture comprising a computer usable medium having computer readable program code configured to conduct the method of claim 35.

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45. An article of manufacture comprising a computer usable medium having computer readable program code configured to conduct the method of claim 39.

15 46. A closure as claimed in claim 1, wherein the first set of threads are dual lead threads.

47. A closure as claimed in claim 17, wherein the threads on the spindle are dual lead.

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